Access to Care in Rural America: Impact of Hospital Closures

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This article employs a quasi-experimental, pre/post comparison group design to determine whether rural hospital closures (n=11) have had a detrimental impact on access to inpatient and outpatient care for the Medicare population. Closure areas experienced a significant decrease in medical admissions, although admission rates remained higher than in comparison areas. Physician services were not found to substitute for inpatient services following a closure. No adverse impacts on mortality were observed. Patients in closure areas were more likely to be admitted to urban teaching hospitals following the closure of their local hospital.

INTRODUCTION

When a rural hospital closes, concerns are raised about the availability and accessibility of alternative sources of inpatient and emergency care. The number of rural hospital closures increased substantially during the 1980s (U.S. General Accounting Office, 1991), and rural closures have continued to occur in the early 1990s (Prospective Payment Assessment Commission, 1994). However, relatively little is known about the effects of closures on the population previously served by the closing hospital. This article has three main objectives: (1) to examine where patients go for health care before and after the closure of acute-care hospitals; (2) to evaluate the effects of hospital closures on inpatient utilization rates; and (3) to explore the relationship between the utilization of physician services and changes in the availability of hospital services. Our work is unique in that both hospital and physician utilization measures are used to examine changes in medical services provided following a rural hospital closure.

Prior research on hospital closures has focused on identifying factors that place a hospital at risk of closure (Office of the Inspector General, 1989; U.S. General Accounting Office, 1990, 1991; Office of Technology Assessment, 1990; Hall, 1991; Mullner and McNeil, 1986; Mullner et al., 1989; Samuels et al., 1990; Williams, Hadley, and Pettengill, 1992). The U.S. General Accounting Office (GAO) (1990) found that low occupancy rates, small size, and ownership by a for-profit entity were associated with a higher risk of hospital closure. Rural hospitals were not more likely to close than urban hospitals, controlling for other factors. Rather, rural hospitals tended to be at higher risk of closure because they were smaller, had low occupancy rates, higher expenses than revenues, and a high proportion of bad debt. Other factors associated with a higher risk of closure were location in a market with a declining population and demand for inpatient days (Samuels et al., 1990), lack of Joint Commission on Accreditation of Healthcare Organizations (JCAHO) accreditation, location in a county with more competitive hospital beds (Mullner et al., 1989), a low volume of surgery, and an extreme volume (either high or low) of outpatient visits (Williams, Hadley, and Pettengill, 1992). In summary, these studies are remarkably consistent in their identification of the characteristics associated with a high risk of closure.

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ASSESSING CLOSURE IMPACTS

Three approaches to assessing the potential impacts of closure on access to care have been identified. One approach is to measure the remaining resources available to the population the closing hospital had served. GAO (1991) and the Office of the Inspector General (1989) measured travel distances and times between closing hospitals and other hospitals with the capacity to treat additional patients. These studies found that, in the majority of cases, another hospital was located within 25 miles of the closing hospital. Additionally, prior to closure, many residents bypassed the local hospital and traveled to other nearby facilities for care. However, even if other hospitals are close by, hospital closure may result in impaired access to care for some portion of the population it had served. Reardon et al. (1991) examined distance and travel times to the nearest hospitals as well as medical resources remaining in the county for a sample of counties in which the sole hospital closed. Although most counties had another hospital within 30 miles, interviews with officials in counties experiencing a closure indicated a tremendous impact on acute and emergency room access. This perceived impact was most severe for the elderly, for whom travel is often difficult, and the poor, who have relatively high out-of-pocket transportation fees to reach the nearest hospital. The weakness of this approach is that it does not examine actual patient use.

A second approach to assessing impacts of closures on access to care is to measure the effects of closure on hospital utilization by the population that had actually used the hospital before it closed. Bindman, Keane, and Lurie (1990) tracked a sample of patients who were treated at a rural public hospital before its closure. Surveys 1 year post-closure found that a greater percentage of these patients had no regular provider and were denied care than patients treated at a comparison hospital. Unfortunately, since this study analyzed only one closing hospital, these results may not be generalizable to other rural closures. Hadley and Nair (1991) examined patterns of hospital utilization by Medicare beneficiaries discharged from rural hospitals that later closed. The comparison group was a sample of patients treated at a hospital of similar bed size in the same or an adjoining county. They concluded that having been a patient at a hospital that closed had no effect on overall hospital use. The authors acknowledge that people who have already been hospitalized represent a self-selection of the population and that their experiences may not be representative of those with a new or first-time health problem.

A third, alternative approach that avoids this problem is to follow the population residing in the hospital's market area prior to the closure (including both users and non-users of the closing hospital) and look at utilization patterns following the closure. Using this strategy, GAO (1991) concluded that Medicare beneficiaries generally suffered no effects on access to care following a closure. The study found that, relative to the national average, utilization rates in the closure areas had a significantly larger decrease (above and beyond the secular trend). Nevertheless, the absolute rate of discharges per capita after the closure remained at rates at or above the national average rate. However, the GAO study did not standardize for potential age-sex differences between the closure areas and the national average rate. In addition, problems with access for a particular population or type of illness may be masked by the level of aggregation.

ANALYTIC APPROACH

Research Design

This article tests whether a hospital closure has a measurable effect on utilization and expenditures within an area that relied upon the hospital prior to its closure. On one hand, to the extent that the population was reliant on a given hospital, the closure might impose a barrier to access. However, if people bypassed the hospital prior to its closure, the closure may not have any perceptible effect on utilization and expenditures. Prior to a hospital closure, the elderly or their physicians may bypass the nearest hospital in favor of a more distant facility because of concerns over quality, availability of high-technology procedures, or other factors.

This study uses a multiple time-series design to examine the impact of hospital closures on Medicare utilization and expenditures (Campbell and Stanley, 1963). Outcome measures are obtained for the year before closure, the year of closure, and the 2 years following the closure. For each area experiencing a hospital closure, two comparison groups have been selected to control for effects that might have occurred independent of the hospital closure. One comparison group includes Medicare beneficiaries in areas that had no hospital closures (nor openings, mergers, or conversions) during the period of study. The second comparison group includes those in areas in which there were no hospitals during the entire study period.

The comparison groups control for external factors that may account for changes in Medicare use and spending independent of the hospital closure. For example, inpatient admission rates and lengths of stay have experienced a downward secular trend. Without an independent comparison group, one might attribute reductions in inpatient admissions to a hospital closure, when in fact, hospital admissions have been declining nationally. The no-hospital-closure areas were chosen to be as similar to the closure areas as possible. Thus, they are the best controls for predicting what would have happened in the closure areas, had the closures not occurred. Areas with no hospitals may have adapted to the lack of a facility through use of other health care providers or networks to ensure access to a hospital. A decrease in care in the closure area to a level below that seen in the no-hospital area may be indicative of access problems in areas that have not made such a transition.

The multiple time-series design is preferable to the non-equivalent control-group design, which has only one pre and one post measure (Campbell and Stanley, 1963). The availability of time-series measures allows greater certainty in attributing the observed effects to the intervention (in this case, the hospital closure). Moreover, lagged effects may be more appropriately observed through time-series measures if they take more than 1 year to observe. Conversely, short-run effects may occur in the year post-closure but not beyond that time horizon.

Outcome Indicators

We employ multiple utilization and expenditure measures to provide a broad perspective on the possible impacts of hospital closures. Unique to this study is the inclusion of measures of physician use (in addition to hospital use) to account for the possible substitution of office-based for hospital-based services. Alternatively, we may observe a complementary relationship, such that a reduction in hospital beds may result in a concurrent reduction in access to physician services in the office or other settings.

The basic thrust of the empirical analysis is to decompose per capita expenditures in rural closure areas versus no-closure and no-hospital areas for both Part A and Part B services. On the Part A side, per capita spending ($\$/B$) is a function of the average reimbursement per discharge ($\$/D$) times the number of discharges per beneficiary (D/B). The average reimbursement per discharge is a function not only of the locus of care (i.e., teaching hospital, urban hospital), but also the mix of medical and surgical discharges and the propensity towards high-technology discharges.

Inpatient days are also examined as a measure of changing discharge patterns. In the closure areas, do we see a more rapid decline in the number of days per beneficiary than in other areas? Is this a function of shifts from low-occupancy local hospitals to higher-occupancy tertiary facilities?

The distribution of hospital discharges by selected hospital characteristics (teaching status, urban location, rural referral center [RRC], bed size) is also examined to identify underlying trends in admission patterns. Do closure areas experience a more significant shift of rural beneficiaries into urban facilities (relative to the no-closure and no-hospital areas)? Are there significant differences in the use of teaching hospitals during the pre- and post-closure periods?

On the Part B side, we examine per capita spending ($\$/B$) and two of its components, the number of users per beneficiary (U/B), and the number of services per user (S/U). As with hospital spending, per capita spending for Part B services is driven by the mix of services, including type of service (visits versus surgery), specialty (general/family practice versus specialist), and place of service (office versus hospital). Consultation services are also examined. These are generally considered a referral service, in which one physician seeks the opinion or advice from another physician concerning the diagnosis or treatment of a specific problem.

Next, indicators of beneficiary liability are included to capture the direct costs to Medicare beneficiaries. For example, if services shift to more costly facilities or providers (e.g., teaching hospitals/physicians), utilization rates may not be affected, but the beneficiary may experience a noticeable increase in the amount paid out-of-pocket. Likewise, if the mix of physicians changes within a community due to a hospital closure, assignment rates could be affected, with a potential increase or decrease in balance billing of the elderly.

Finally, the mortality rate (age- and sex-adjusted) reflects the most extreme health status outcome resulting from hospital closure. We test whether a change in death rates is observed following the closure of a rural hospital. Unfortunately, our sample sizes are not large enough to allow disaggregation of mortality rates by site of death or type of condition. It should be noted that other factors in addition to hospital closure (i.e., local morbidity, change in quality at referral hospitals used by area residents) may affect mortality rates.

METHODOLOGY

Sample of Rural Hospital Closures

Rural hospital closures were identified in States for which complete Medicare Part A and Part B claims data were available from 1985-89.[1] The eligibility criteria for the study sample were as follows: Hospitals had to be Medicare-certified, short-term, general acute-care facilities which closed in either 1986 or 1987. (For the purpose of this article, closure is defined as the cessation of inpatient care.) Hospitals that converted from

[1] The 11 States were: Alabama, Arizona, Connecticut, Georgia, Kansas, New Jersey, Oklahoma, Oregon, Pennsylvania, Washington, and Wisconsin. These States are included in the CHER Eleven-State Data Base, containing the universe of Part B claims from 1985-89 (except Wisconsin, which did not report data for 1989).

acute-care to non-acute-care status were included, as were mergers that resulted in a conversion to a non-acute-care facility.

Eleven rural hospital closures in six States were identified. Eight of the 11 closures took place in 1987, and the remaining 3 in 1986. All but one hospital closed permanently. The hospitals included in the study are listed in Table 1.

Of the 11 hospitals, 3 were publicly owned, 4 were private non-profits, and 4 were for-profit hospitals. Five hospitals were accredited by JCAHO, and none had a medical school affiliation (data not shown). Six hospitals had fewer than 50 beds, and only 1 had more than 100 beds. Thus, most were much smaller than the rural hospital average of 86 beds (American Hospital Association, 1985). All but 1 of the closing hospitals (91 percent) had an emergency department. Five had an organized outpatient department (45 percent), providing outpatient access for routine and/or specialty services.

Closing hospitals had a mean occupancy rate of 48.3 percent in 1984; only 2 of the hospitals had an occupancy rate exceeding the national average occupancy rate of 75.7 percent for rural hospitals in 1984 (American Hospital Association, 1985). By 1986, only 3 of the rural hospitals had maintained an occupancy rate exceeding 60 percent. All three closed permanently the following year. Thus, our sample is consistent with GAO (1990) findings that low occupancy rates, small size, and ownership by a for-profit entity were associated with a higher risk of closure.

Medicare patient days averaged 45.6 percent of total days, and Medicaid days accounted for 12 percent of total days, on average. In general, the closing hospitals ranked below average on the Medicare case-mix index, with 9 of the 11 hospitals having a score below 1.00.

Market shares for the closing hospitals in 1984 ranged from 2.5-23.3 percent. Thus, many residents of the hospitals' service areas were bypassing the hospital and seeking care elsewhere 2-3 years before closure. Nine of the 11 hospitals had nearby alternatives, including 7 which were served by 1 alternative hospital, 1 with 2 close neighbors, and 1 with 3 nearby alternatives (data not shown). In all cases, the alternate facilities offered emergency services. In most cases, alternatives were larger than the closing hospitals. The 2 remaining hospitals had no competing facilities within a 15-mile radius.

Definition of Closure Areas

Populations affected by a hospital closure were identified on the basis of pre-closure utilization patterns. Hospital service areas focus on realized access (those who actually use the hospital) instead of potential access (the population that the hospital may be trying to target). This concept was developed in the small area analysis literature and is typically defined by a collection of ZIP Codes, census tracts, or other geographic areas from which the residents rarely depart for hospital care (Rohrer, 1987). Hospital service areas are frequently developed on the basis of patient origin data, namely ZIP Code-level admission or discharge data (Wright and Marlor, 1990).

Griffith (1972) proposed two measures of the importance of a hospital to a given area: the relevance index, reflecting the proportion of an area's admissions accounted for by a given hospital; and the commitment index, indicating the proportion of a hospital's admissions from a given area.[2] The relevance index can be interpreted, therefore, as the importance of the hospital to the ZIP Code (i.e., the popula-

[2] Algebraically, these two measures are computed as: (1) relevance index for hospital i = discharges from hospital i from area j/total discharges from area j; and (2) commitment index for hospital i = discharges from hospital i from area j/total discharges from hospital i.

Table 1

Selected Characteristics of Rural Hospital Closures Included in the Sample[1]

Hospital and State	Year of Closure	Beds	Ownership	JCAHO Accreditation	Emergency Department	Outpatient Department	Occupancy Rate (Percent) 1984	Occupancy Rate (Percent) 1986	Percent Medicare Days	Percent Medicaid Days	Medicare Case-Mix Index	Percent Market Share (1984)
Alabama												
John A. Andrew Community Hospital	1987	51	Non-Profit	Yes	Yes	No	76.5	43.4	42.2	15.0	0.92	18.1
Guin Hospital	1987	21	For-Profit	No	No	No	33.3	NA	53.2	9.9	0.92	8.4
Livingston-Tombigbee Regional Medical Center	1987	72	For-Profit	No	Yes	Yes	31.9	19.4	46.4	7.7	0.93	12.5
Georgia												
Fort Gaines Hospital	1987	84	Public	No	Yes	No	73.8	65.5	41.5	18.4	0.93	14.6
Oklahoma												
Afton Memorial Hospital	1986	26	For-Profit	No	Yes	No	26.9	26.9	46.0	9.7	0.87	2.5
Jay Memorial Hospital	1987	28	For-Profit	Yes	Yes	No	28.6	21.4	68.7	18.8	1.02	21.7
Oregon												
Pendleton Community Hospital	1986	55	Non-Profit	Yes	Yes	Yes	21.7	NA	49.5	9.8	0.88	8.9
New Lincoln Hospital	1986	29	Public	No	Yes	Yes	39.3	NA	34.5	15.2	0.97	17.4
Washington												
Monticello Medical Center	1987	110	Non-Profit	Yes	Yes	No	46.4	32.8	24.2	15.4	1.09	16.6
Wisconsin												
Algoma Memorial Hospital	1987	39	Public	Yes	Yes	Yes	68.5	68.8	49.8	NA	0.99	16.8
Buffalo Memorial Hospital	1987	29	Non-Profit	No	Yes	Yes	84.5	71.6	NA	NA	0.96	23.3

[1] Includes Medicare-certified, short-term, acute-care hospitals that closed during 1986-87 or that changed from acute care to non-acute-care status.

NOTES: *JCAHO is Joint Commisssion on Accreditation of Healthcare Organizations. NA is not available.*

SOURCES: Center for Health Economics Research: Hospital Universe file, 1986-87; American Hospital Association: *Annual Survey of Hospitals*, 1984-86; Health Care Financing Administration: PPS Impact file, 1984.

tion residing in the ZIP Code). The commitment index measures the importance of the ZIP Code to the hospital.

Because of our population-based focus, we developed hospital service areas based on a patient origin study. Admission patterns prior to hospital closure were analyzed using the 100-percent Medicare Part A claims files for 1984 and 1985.

First, ZIP Code areas were ranked by the relevance index, i.e., the number of discharges from the closed hospitals as a proportion of all discharges for patients living in the ZIP Code area. ZIP Codes for which the hospital provided at least 5 percent of the discharges were included in the service area. If these ZIP Codes accounted for more than 60 percent of total discharges from the hospital, the process stopped, and these ZIP Codes were defined as the service area. If these ZIP Codes accounted for less than 60 percent of total discharges from the hospitals, ZIP Codes were added based on the percent of discharges from the hospital until all ZIP Codes accounting for more than 1 percent of the hospitals' discharges were included.

One of the issues we examined was border crossing; to the extent that beneficiaries within the service areas sought care outside of the States included in the CHER Eleven-State Data Base, data would not be available on their Part B utilization and expenditures. For 10 of the 12 closure areas, at least 99 percent of admissions occurred within the State in which the hospital was located. In one case, the admissions were divided between two States, both of which were included in the data base (Alabama/Georgia). In the final case, the admissions were almost evenly divided between Oklahoma and Missouri. However, the ZIP Code in Missouri accounted for only 4 percent of the admissions to the closing hospital. Moreover, the relevance index for that particular ZIP Code was less than 5 percent, indicating that the population in the ZIP Code was not particularly dependent on the closing hospital. Thus, the Missouri ZIP Code was excluded from the service area for the closing hospital for the purpose of this analysis.

An additional issue arose for hospitals which had overlapping hospital service areas. This occurred in Oklahoma, where two hospitals serving one ZIP Code area closed during 1986 or 1987. One option for handling overlapping ZIP Codes would be to assign the ZIP Code to the area which relied most on the hospital. However, because the beneficiaries in these ZIP Code areas depended on both closing hospitals to some extent, they were potentially subject to more limited access to hospital care. As a result, a separate hospital service area was created containing only the overlapping ZIP Codes. In this way, the effect of the dual closures on these populations can be measured. Thus, there were a total of 12 closure areas included in the analysis.

Definition of Comparison Areas

The quasi-experimental design requires comparison populations with similar demographic characteristics to control for secular trends in utilization and expenditures. Based on data from the Area Resource File, we matched closure areas with demographically similar rural counties (within the same State) that had no closures or no hospitals during the study period. The SAS CLUSTER procedure was used to create dendograms indicating the counties most similar to our closure areas. The match was based on four variables: population density; per capita income; percent of the population that is minority; and percent of the population that is elderly. We intentionally excluded variables that could be considered endogenous, such as physicians per capita, from the analysis.

In many instances, the CLUSTER procedure yielded several counties, rather than a single county, that were statistically good matches with the closure area. Our examination of the demographic data indicated that population density was much more variable than the other demographic characteristics. Thus, when multiple matches occurred, we selected the county whose population density most closely matched the closure area.[3] This trade-off meant selecting a county with a more similar population density but slightly less similar per capita income or percentage minority population. This procedure is a refinement to that used by Reardon et al. (1991), who randomly selected one comparison county.

The number of Medicare beneficiaries tended to be somewhat smaller in closure areas (1,102-10,488 beneficiaries) than in no-closure areas (1,742-12,447 beneficiaries), but somewhat larger than in no-hospital areas (735-4,808 beneficiaries).

Construction of Outcome Measures

Outcome measures were constructed using data from several sources. Medicare Provider Analysis and Review files for 1985-89, providing 100-percent data on Part A Medicare claims, were used in constructing measures of inpatient utilization and expenditures. One hundred-percent Part B Medicare claims data were obtained from CHER's Eleven-State Data Base to construct measures of physician utilization and expenditures. Finally, Medicare eligibility and enrollment data were used to create the denominators as well as the mortality rates. For each area, we used data from the year prior to closure, the year of closure, and the 2 years post-closure. Thus, for 1986 closures, our time series runs from 1985-88; for 1987 closures, it runs from 1986-89.

The direct method of standardization was used to adjust each outcome indicator for possible differences in age and sex distributions of Medicare beneficiaries residing in the closure areas and comparison counties (Mausner and Kramer, 1985). The age-sex distributions in the study sample (closure and comparison areas combined) were used for the adjustments. All Part B expenditure measures have been adjusted by the Geographic Practice Cost Index to account for differences in geographic practice costs across the closure and comparison areas (Welch, Zuckerman, and Pope, 1989). Part A expenditures were left unadjusted, since no single index exists for hospital services.

Statistical Methods

To test whether our outcome measures were affected by hospital closures for the closure service areas, we utilized profile analysis (Morrison, 1976). Profile analysis can be used to test for the effects of an intervention by testing for statistically meaningful differences in trends across time for the study and comparison groups. The first step in profile analysis is the calculation of the mean value and standard deviation for each analytic group (closure or comparison) for each time point. Profile analysis does not test whether these mean values are significantly different at each time point. Instead, it tests for trend differences by testing whether the change in the mean value is statistically different for the two analytic groups across time. For instance, profile analysis would compare the line segments formed by mean values (and associated within-group variation) for the closure and comparison groups for the year before hospital closure and the year of closure. If the slopes of the two segments were not significantly different (i.e., the

[3] Two exceptions to this procedure were made. Both Oregon and Washington contained three counties that have no hospitals. All six counties had very low population density (with low total populations). To increase the total number of discharges in the comparison areas, we utilized data from all three counties in Oregon to create the no-hospital area for comparison with the Oregon closure area and all three counties in Washington for comparison with the Washington closure area.

change in mean values does not differ significantly for the two groups), the analysis would imply that the closure had no significant effect in that year. Our analysis tested for significance in each of three time periods: the year before closure to the year of closure; closure to 1 year post-closure; and 1-2 years post-closure.

Profile analysis was also used to test for overall differences in the profile across all 4 years. It was performed first for differences between the closure areas and no-closure counties, and then for differences between the closure areas and no-hospital counties. Profile analysis was performed in SAS using the Profile option in the GLM procedure (SAS Institute, Inc., 1989).

In the tables that follow, significant results are noted in relation to the comparison group according to the year in which the trend was observed. For example, we indicate a significant difference in per capita expenditures under Part A between the closure and no-hospital areas during the time period between 1 and 2 years post-closure by placing an asterisk next to the no-closure observation for 2 years post-closure. If the overall trend for the 4-year time period shows significant differences, the asterisk appears in the column labeled "significance of 4-year trend." Although the overall profile is not simply testing for differences in percent change pre-closure and 2 years post-closure, we include the percent change on all tables for the reader's convenience.

RESULTS

Inpatient Utilization and Expenditures

Inpatient expenditures per capita ($\$/B$) can be decomposed as the product of average reimbursement per discharge ($\$/D$) and the number of discharges per beneficiary (D/B). Increasing expenditures per capita may result from increases in average reimbursement per discharge, indicating a change in the locus of care (i.e., to teaching or urban hospitals), the mix of medical and surgical discharges, or the complexity of those discharges. Decreases in spending per capita may be the result of fewer discharges per capita as a result of diminished access to care.

Table 2 presents per capita expenditures, discharges per 1,000 beneficiaries, average charge per discharge, and days per 1,000 beneficiaries for all Medicare discharges. Growth in per capita expenditures was slower in the closure areas (5.1 percent) than in either the no-closure areas (11.6 percent) or the no-hospital areas (15.3 percent). This is similar to the result found by the Prospective Payment Assessment Commission (1990) comparing rural counties with a closure and those with no closure. While expenditures per capita were slightly higher in the closure areas than the comparison areas 1 year before closure, they were 3 percent lower than in the comparison areas 2 years post-closure.

Lower growth in per capita expenditures appears to result primarily from a greater decrease in discharges per capita in the closure areas, relative to the comparison areas. The discharge rate in the closure areas was 19 percent higher than that of the comparison areas before the hospital closure; post-closure, the discharge rate in the closure areas remained higher than for the no-closure areas, but the differences among the areas had diminished (although the change was not statistically significant). Days per 1,000 beneficiaries also decreased more rapidly (11.7 percent) in the closure area than in either comparison area. The discharge rates and trends in rates for our closure and comparison areas are similar to those found for 1986 closures and the Nation as a whole (U.S. General Accounting Office, 1991).

Table 2
Trends in Total, Medical, and Surgical Inpatient Utilization Under Medicare

Utilization Measure	One Year Before Closure	Year of Closure	Post-Closure 1 Year	Post-Closure 2 Years	Percent Change	Significance of 4-Year Trend
Total						
Per Capita Expenditures						
Closure	$1,167	$1,162	$1,145	$1,226	5.1	—
No Closure	1,134	1,056	983	***1,266	11.6	**
No Hospital	1,089	1,131	1,086	*1,256	15.3	—
Discharges per 1,000 Eligibles						
Closure	391	345	332	332	-15.1	—
No Closure	329	298	295	300	-8.8	—
No Hospital	331	309	296	313	-5.4	—
Average Charge per Discharge						
Closure	$3,062	$3,338	$3,470	$3,672	19.9	—
No Closure	3,655	3,539	3,646	*4,107	12.4	—
No Hospital	3,396	3,582	3,859	4,243	24.9	—
Days per 1,000 Eligibles						
Closure	2,644	2,442	2,367	2,334	-11.7	—
No Closure	2,397	2,223	2,196	2,310	-3.6	—
No Hospital	2,263	2,154	2,008	**2,315	-2.3	—
Medical						
Per Capita Expenditures						
Closure	$629	$609	$604	$619	-1.6	—
No Closure	604	539	489	***598	-1.0	**
No Hospital	554	557	523	*608	9.7	—
Discharges per 1,000 Eligibles						
Closure	302	261	246	244	-19.0	—
No Closure	239	212	209	213	-10.9	—
No Hospital	242	**231	215	221	-9.0	—
Average Charge per Discharge						
Closure	$2,129	$2,313	$2,420	$2,498	17.3	—
No Closure	2,696	2,443	2,503	**2,816	4.5	—
No Hospital	2,347	2,488	2,615	*2,915	24.2	—
Days per 1,000 Eligibles						
Closure	1,825	1,646	1,551	1,530	-16.2	—
No Closure	1,575	1,440	1,402	1,492	-5.3	*
No Hospital	1,506	1,419	1,294	*1,425	-5.4	*
Surgical						
Per Capita Expenditures						
Closure	$538	$553	$542	$601	11.7	—
No Closure	530	517	494	*669	26.2	—
No Hospital	535	574	564	648	21.1	—
Discharges per 1,000 Eligibles						
Closure	90	84	85	88	-2.3	—
No Closure	90	85	86	87	-3.2	—
No Hospital	88	79	81	92	-4.0	—
Average Charge per Discharge						
Closure	$6,124	$6,146	$6,399	$6,825	11.4	—
No Closure	5,855	6,547	6,491	6,981	19.2	—
No Hospital	5,994	6,119	6,661	7,252	20.9	—
Days per 1,000 Eligibles						
Closure	819	796	816	804	-1.8	—
No Closure	822	783	794	818	-0.5	—
No Hospital	757	736	714	**890	17.6	—

* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

NOTES: An asterisk next to any year's data indicates a significant difference in the trend for the closure area and the comparison area between that year and the previous year. An asterisk in the column labeled "Significance of 4-Year Trend" indicates profile analysis detected a significant difference in the trend across the 4 years.

SOURCE: Health Care Financing Administration: Medicare Provider Analysis and Review Files, 1985-89.

It is possible that aggregation of total discharges is masking trends among particular types of cases. Table 2 also presents data for medical and surgical discharges separately. Both medical and surgical per capita expenditures grew more slowly in the closure areas than in the comparison areas. Medical expenditures in the closure areas decreased 1.6 percent after the closure, compared with a 1-percent drop in the no-closure areas and a 9.7-percent increase in the no-hospital areas. This decrease in expenditures is a result of the large decrease in medical discharges per capita in the closure areas. One year before closure, the discharge rate in the closure areas was 26 percent greater than the comparison areas; 2 years post-closure, the rate was only 14 percent greater. In particular, the reduction during the year of closure was greater in the closure areas than in the no-hospital areas. Similarly, medical days per 1,000 beneficiaries fell significantly more in the closure areas than in either comparison area. The large differences in baseline measures complicate interpretation of these results. Although days and discharges per capita fell more in the closure areas than in the comparison areas, rates 2 years post-closure were still higher in the closure areas than in the no-hospital or no-closure areas.

Surgical expenditures per capita grew rapidly in all areas, although somewhat less rapidly in the closure areas than the comparison areas. This rapid growth appears to be primarily the result of large increases in charges per discharge across all areas, whereas discharge rates are quite similar for all observations. Surgical days per 1,000 beneficiaries fell slightly in both the closure and no-closure areas; in contrast, the no-hospital areas experienced a 17.6-percent increase in days per capita.

To further examine the decomposition of total Medicare discharges, we classified diagnosis-related groups (DRGs) into eight distinct case types (Codman Research Group, Inc., 1991). Case types are created by grouping DRGs according to several criteria: whether admissions are local or referral-oriented; the degree of geographic variation in admission rates; and the medical or surgical nature of the admission. Table 3 presents data for two selected case types which might be particularly affected by a hospital closure: ambulatory-care sensitive and medical-local. (The Technical Note at the end of this article defines the DRGs which make up these two case types.)

Ambulatory-care sensitive cases are medical admissions for which management of the condition on an outpatient basis may help avoid or reduce the need for hospitalization. Following hospital closures, we would expect to see patients traveling further for hospital care and, perhaps, a decrease in physicians located in the closure area. As a result, we would expect to observe increases in ambulatory-care sensitive discharges, as less support would exist for patients receiving treatment on an outpatient basis. Instead, ambulatory-care sensitive discharges in the closure areas fell significantly more than in both comparison areas, and almost all of this decrease occurred in the year of the hospital closure. One explanation for this phenomenon would be the presence of a different threshold for treating patients as inpatients rather than outpatients in different hospitals. If physicians in the closing hospitals had a much lower threshold for admission (i.e., they were much more likely to choose inpatient treatment than physicians at other hospitals), then the closure would result in a decrease in inpatient treatment as the population of the service area sought treatment at other hospitals. This explanation would be consistent with the high level of ambulatory-care sensitive discharges in

Table 3

Trends in Inpatient Utilization for Two Case Types Under Medicare

Utilization Measure	One Year Before Closure	Year of Closure	Post-Closure 1 Year	Post-Closure 2 Years	Percent Change	Significance of 4-Year Trend
Ambulatory Care Sensitive						
Per Capita Expenditures						
Closure	$182	$172	$174	$182	0.0	—
No Closure	130	145	133	154	18.5	—
No Hospital	142	151	142	160	12.7	—
Discharges per 1,000 Eligibles						
Closure	89.8	76.1	74.2	74.2	-17.4	—
No Closure	65.4	**61.5	60.6	64.2	-1.8	**
No Hospital	66.4	**66.1	62.0	62.2	-6.3	**
Average Charge per Discharge						
Closure	$2,058	$2,220	$2,290	$2,424	17.8	—
No Closure	2,196	2,382	2,313	2,585	17.7	—
No Hospital	2,228	2,408	2,501	2,709	21.6	—
Days per 1,000 Eligibles						
Closure	525.0	467.9	447.1	435.7	-17.0	—
No Closure	402.9	*392.4	386.3	417.2	3.5	***
No Hospital	414.2	411.7	354.9	*392.7	-5.2	—
Medical-Local						
Per Capita Expenditures						
Closure	$206	$193	$196	$197	-4.4	—
No Closure	173	166	159	*217	25.4	*
No Hospital	178	176	181	210	18.0	—
Discharges per 1,000 Eligibles						
Closure	116.9	98.5	88.0	86.7	-25.8	—
No Closure	91.4	78.5	**78.7	75.6	-17.3	—
No Hospital	92.7	*83.8	81.6	85.2	-8.1	*
Average Charge per Discharge						
Closure	$1,828	$1,971	$2,135	$2,214	21.1	—
No Closure	2,016	2,139	2,250	2,674	32.6	—
No Hospital	2,009	2,166	2,389	2,845	41.6	—
Days per 1,000 Eligibles						
Closure	651.1	584.4	541.7	524.2	-19.5	—
No Closure	551.6	506.3	502.6	522.8	-5.2	—
No Hospital	527.3	470.3	457.9	534.1	1.3	**

* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

NOTES: An asterisk next to any year's data indicates a significant difference in the trend for the closure area and the comparison area between that year and the previous year. An asterisk in the column labeled "Significance of 4-Year Trend" indicates profile analysis detected a significant difference in the trend across the 4 years. The Technical Note at the end of this article defines the specific diagnosis-related groups which make up the two case types.

SOURCE: Health Care Financing Administration: Medicare Provider Analysis and Review Files, 1985-89.

the closure areas. Ambulatory-care sensitive discharges per capita were 37 percent higher in the closure areas than the comparison areas the year before the closure; 2 years after the closure, the difference had diminished to 16 percent.

Medical-local cases are those for which local, often small, hospitals account for a majority of admissions from rural areas. These include many of the most frequently admitted medical conditions, for which rural beneficiaries are rarely referred to large, more sophisticated hospitals. Trends in per capita expenditures, discharges per capita, and charge per discharge for medical-local cases are similar to those for the ambulatory-care sensitive cases. The closure areas had a much lower growth in per capita expenditures than the comparison areas as a result of large decreases in discharges per capita. Medical-local discharges per capita were 28 percent higher in the closure areas than the no-closure areas the year before the closure; 2 years after the closure, the discharge rate was only 15 percent higher.

Table 4

Trends in Medicare Hospital Discharges, by Hospital Characteristics

Hospital Type	One Year Before Closure	Year of Closure	Post-Closure 1 Year	Post-Closure 2 Years	Percent Change	Significance of 4-Year Trend
			Percent of Discharges			
Urban Hospitals						
Closure	30.7	34.9	38.7	39.2	27.8	—
No Closure	29.8	32.1	34.1	35.1	17.7	—
No Hospital	43.1	43.4	43.0	44.3	2.7	*
Teaching Hospitals						
Closure	21.8	24.7	26.9	27.8	27.6	—
No Closure	17.3	19.5	19.1	20.9	20.7	—
No Hospital	29.5	30.3	29.9	31.3	6.3	—
Rural Referral Centers						
Closure	13.5	15.3	16.5	16.2	19.7	—
No Closure	23.0	*22.8	22.8	22.8	-0.9	—
No Hospital	9.6	9.9	11.1	18.3	91.6	—
Average Bed Size						
Closure	172	188	189	192	11.1	—
No Closure	198	208	213	211	6.8	—
No Hospital	201	205	203	201	0.1	*

* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

NOTES: An asterisk next to any year's data indicates a significant difference in the trend for the closure area and the comparison area between that year and the previous year. An asterisk in the column labeled "Significance of 4-year Trend" indicates profile analysis detected a significant difference in the trend across the 4 years.

SOURCES: Health Care Financing Administration: Medicare Provider Analysis and Review Files, 1985-89; PPS Impact file, 1985-89.

Discharges per capita were similar in the closure and no-hospital areas both prior to closure and 2 years post-closure.

The reasons for this decline in discharge rates are unclear. Decreasing discharge rates for medical-local discharges would be consistent with diminished access to hospital care. However, without detailed information on the health status of the populations, we cannot determine whether the high initial discharge rate reflected overhospitalization in the closure areas, or whether the diminished rate reflects inadequate access for this population group after closure.

Inpatient Discharges by Hospital Characteristics

One of the hypothesized effects of rural hospital closures is the shift of admissions to more sophisticated and more costly facilities. Urban hospitals are more expensive, on average, than rural facilities; teaching hospitals are more expensive than non-teaching hospitals. Quality of care may be enhanced if patients are treated in facilities with more comprehensive services.

Indeed, as shown in Table 4, there were several significant shifts in hospital utilization patterns following the closure of rural hospitals. The closure areas experienced a 28-percent increase in the percent of admissions to urban hospitals, reflecting a marked shift in admissions from rural to urban hospitals far exceeding the change for the no-hospital areas. As might be expected, the no-hospital areas made consistently higher use of urban hospitals than the other two areas, although the level of urban admissions was stable during the 4-year period. Admissions to teaching hospitals rose 28 percent in the closure areas, versus only 6 percent in the no-hospital areas. However, this trend was not found to be statistically significant in the profile analysis.

The closure and no-hospital areas showed an opposite trend in admissions to

RRCs[4] compared with the no-closure areas. In particular, during the year of the closure, admissions to RRCs rose in the closure area (from 13.6 to 15.3 percent of the total), compared with a slight decline in the no-closure areas. GAO (1991) also found that admissions to RRCs rose after hospital closures.

Consistent with the shift to urban hospitals is a significant increase in the average bed size of the hospitals to which Medicare beneficiaries were admitted post-closure. For example, in the year prior to closure, average bed size was 172 beds, rising 11 percent in the year of closure to 192 beds. In contrast, the no-hospital areas had more consistent admission patterns, with bed size averaging about 200 beds over the 4-year period. With respect to the no-closure areas, a more moderate, but non-significant, shift was observed according to bed size, urban location, and teaching status.

Physician Utilization and Expenditures

Table 5 displays trends in Medicare Part B expenditures both on a per capita and per user basis. Per capita expenditures grew significantly more slowly in the post-closure period in the areas that experienced a hospital closure. Between 1 and 2 years post-closure, Part B expenditures grew only 6.2 percent in the closure areas (from $780 to $828) compared with 14.4 percent in the no-closure areas ($821 to $940) and 16.4 percent in the no-hospital areas ($842 to $981).

Expenditures per user focuses mainly on the intensity of services received. Average expenditures per user post-closure rose more rapidly in the two comparison areas than in the closure areas, although there were no statistically significant differences in the 4-year trend line. The number of users per 1,000 beneficiaries also showed no differences across the 3 areas.

Clear differences in spending by location of service are observed. More rapid growth in both inpatient and outpatient hospital spending occurred post-closure in the no-closure and no-hospital areas, as well as faster growth in office-based expenditures in the no-closure areas. These changes appear to be driven largely by changes in the amount of spending per user rather than in the number of users. In other words, we do not see an actual erosion of access as measured by the numbers (or rates) of Medicare beneficiaries receiving services, but rather in terms of the amount (or mix) of services that users are receiving.

The slower growth in expenditures per capita and per user can be explained by differential patterns of spending according to type of service (data not shown). In particular, surgical expenditures (both per capita and per user) experienced slower growth in the closure areas. Likewise, spending for hospital visits grew more slowly in the closure areas. Interestingly, the closure and no-closure areas had fairly comparable levels of Part B spending for hospital visits in the pre-closure period ($49-$51). Yet 2 years post-closure, spending growth was nearly double in the no-closure areas, resulting in a 17-percent differential. The slower spending growth in closure areas was a function of lower rates of utilization post-closure. In the year before closure, 163 beneficiaries per 1,000 had hospital visits in the closure areas, versus 155 beneficiaries per 1,000 in the no-closure areas. By 2 years post-closure, the closure areas had a significantly lower rate of use (174 per 1,000) than those in the no-closure areas (185 per 1,000). As previously discussed, it is unknown whether this reduction in inpatient physician use reflects barriers to access or is the result of reductions in inappropriate use.

[4] RRCs are "generally large, offer a broad range of services, and treat patients from a wide geographic area. Under the [Medicare prospective payment system], payments to RRCs are based on the standardized amount for 'other urban' areas" (U.S. Congressional Budget Office, 1991).

Table 5

Trends in Medicare Part B Utilization and Expenditures, by Location of Service

Utilization and Expenditure Measures	One Year Before Closure	Year of Closure	Post-Closure 1 Year	Post-Closure 2 Years	Percent Change
All Settings					
Expenditures per Capita					
Closure	502	657	780	828	64.8
No Closure	531	716	821	**940	77.0
No Hospital	595	736	842	**981	64.9
Expenditures per User					
Closure	667	823	964	1,014	52.0
No Closure	678	859	958	***1,079	59.1
No Hospital	755	893	1012	***1,161	53.9
Users per 1,000 Eligibles					
Closure	727	789	803	815	12.0
No Closure	768	834	857	872	13.5
No Hospital	753	811	820	837	11.3
Inpatient Hospital					
Expenditures per Capita					
Closure	205	249	290	292	42.7
No Closure	226	292	314	**354	56.5
No Hospital	239	290	307	**356	49.4
Expenditures per User					
Closure	998	1,139	1,312	1,318	32.0
No Closure	1,107	1,286	1,357	*1,495	35.0
No Hospital	1,205	1,358	1,406	***1,658	37.6
Users per 1,000 Eligibles					
Closure	204	227	226	230	12.6
No Closure	202	231	234	238	17.7
No Hospital	195	215	219	217	11.6
Outpatient Hospital					
Expenditures per Capita					
Closure	75	107	122	125	66.0
No Closure	77	119	139	*153	98.7
No Hospital	83	103	113	***128	54.0
Expenditures per User					
Closure	262	324	370	367	40.1
No Closure	269	331	365	377	40.1
No Hospital	294	304	342	*365	24.4
Users per 1,000 Eligibles					
Closure	278	332	341	353	27.0
No Closure	289	366	385	407	40.9
No Hospital	276	334	324	347	25.7
Office					
Expenditures per Capita					
Closure	142	192	228	252	77.8
No Closure	158	218	255	*297	87.2
No Hospital	184	229	265	302	63.7
Expenditures per User					
Closure	205	259	301	327	59.5
No Closure	219	280	316	360	64.3
No Hospital	250	294	335	376	50.6
Users per 1,000 Eligibles					
Closure	658	722	741	758	15.2
No Closure	709	777	806	823	16.0
No Hospital	691	753	768	785	13.6

* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

NOTES: An asterisk next to any year's data indicates a significant difference in the trend for the closure area and the comparison area between that year and the previous year. None of the 4-year trends was statistically significant.

SOURCE: Center for Health Economics Research: Eleven-State Data Base, 1985-89.

Table 6
Trends in Beneficiary Liability Under Medicare Parts A and B

Liability Measure	One Year Before Closure	Year of Closure	Post-Closure 1 Year	Post-Closure 2 Years	Percent Change
Part A					
Copayment per Discharge					
Closure	$305	$382	$408	$374	22.6
No Closure	297	385	414	391	31.6
No Hospital	317	397	416	388	22.4
Part B					
Copayment per Eligible[1]					
Closure	126	158	181	191	50.6
No Closure	134	172	191	**213	58.9
No Hospital	145	174	193	**219	50.4
Copayment per User[1]					
Closure	169	198	223	233	37.9
No Closure	172	205	223	**245	42.3
No Hospital	186	212	232	**259	39.2
Out-of-Pocket Payment per Eligible[2]					
Closure	173	213	233	244	40.6
No Closure	202	251	267	289	43.5
No Hospital	207	233	251	*278	33.9
Out-Of-Pocket Payment per User[2]					
Closure	235	269	289	298	27.1
No Closure	260	301	311	332	27.9
No Hospital	265	283	302	*329	23.9
Assignment Rate (Percent)					
Closure	63.2	67.6	73.5	77.1	22.1
No Closure	56.2	60.8	66.8	71.9	27.9
No Hospital	63.1	68.6	72.1	76.3	20.9

* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

[1] Includes deductible plus coinsurance.
[2] *Includes deductible plus coinsurance plus potential balance bill on non-assigned cases.*

NOTES: An asterisk next to any year's data indicates a significant difference in the trend for the closure area and the comparison area between that year and the previous year. None of the 4-year trends was statistically significant.

SOURCE: Center for Health Economics Research: Eleven-State Data Base, 1985-89.

Per capita spending for consultations was lower in the closure areas than the two comparison groups pre-closure (data not shown). Spending leveled off between 1 and 2 years post-closure, as did the number of Medicare beneficiaries receiving consults in the closure areas during that time period. Moreover, among those receiving consultative services, the average number of consults declined in the closure areas from 2.08 to 1.84, compared with slight increases in the two comparison areas ($p < 0.10$). Per capita spending growth was slower in the post-closure period for three high-volume Medicare specialties—general/family practice, cardiology and gastroenterology—relative to the areas not experiencing a closure (data not shown).

In general, we see a consistent picture of slower growth in Part B spending per capita within the closure areas, especially with respect to hospital-based services such as surgery and hospital visits. Evidence of a lagged response was observed, with a slight downturn in utilization and/or spending between 1 and 2 years post-closure.

Beneficiary Liability

Table 6 displays trends in beneficiary liability under Part A and Part B pre- and post-closure. The average Part A deductible and coinsurance per discharge was comparable over the 4-year period in all three areas. The downturn 2 years post-closure for all areas is a result of the implementation of the Medicare Catastrophic Coverage Act in 1989.

Under Part B, beneficiary liability could decrease post-closure if Medicare beneficiaries receive fewer physician services.[5] Alternatively, out-of-pocket payments could increase if beneficiaries are treated by more expensive providers (e.g., urban, teaching physicians) or shift to non-participating providers. As shown in Table 6, we observe a slower growth in Part B copayments in the closure areas. For example, between 1 and 2 years post-closure, copayments per capita rose 12-13 percent in the comparison areas versus only 5 percent in the closure areas. Likewise, we observe a slower rate of growth post-closure in copayments per user. When the potential balance bill is included, we see less of an impact, although the post-closure rate of growth was still slower in the closure areas than in the no-hospital areas (that is, between 1 and 2 years post-closure). Patterns of assignment did not change significantly during the 4-year period, although closure areas and no-hospital areas consistently had higher rates of assignment than the no-closure areas. Thus, it would not appear that Medicare beneficiaries have incurred additional out-of-pocket expenses following a hospital closure.

Mortality Rates

One problem encountered repeatedly while examining trends in utilization is the lack of a benchmark with which to determine the appropriate level of care. We have observed that, for many types of inpatient care, utilization rates were quite high in the closure areas the year before closure and fell dramatically after closure. However, utilization rates after closure often remained higher in the closure than in the comparison areas. All our utilization measures were standardized for differences in age and gender across study area populations. However, this standardization cannot adjust for all differences in health status across the study areas. Utilization in the closure areas could have dropped to a level lower than was optimal if the population of these areas had poorer health than those in the comparison areas, even though utilization rates were similar.

To determine the impacts of hospital closures on health status, it would be necessary to have information on the medical outcomes of residents of our study areas. Unfortunately, the only such information available is the mortality rate. This is obviously a crude measure; the closure could adversely affect residents without an increase in mortality.

Table 7 presents adjusted mortality rates for the closure areas and the two comparison areas. The mortality rates in the year before closure were quite similar for the closure and comparison areas, 36.4 per 1,000 and 36.5 per 1,000, respectively. Two years after the hospital closure, mortality in the closure areas had risen to 38.1 per 1,000 (4.7 percent), while the mortality rate in the comparison area decreased 4.4 percent. However, profile analysis of these data show no significant effects from the closure, and a *t*-test reveals that the means 2 years post-closure are not significantly different.

DISCUSSION

This article has employed a quasi-experimental, pre/post comparison group design to determine whether rural hospital

[5] Under Part B, Medicare beneficiaries must meet a deductible of $75. The copayment amount is 20 percent of the Medicare-allowed charge (beyond the deductible). For non-assigned cases (i.e., those in which the physician does not accept Medicare reimbursement as payment in full), the physician may charge the patient for the difference between the submitted and the allowed charge, although not all physicians will necessarily collect the "balance bill" amount.

Table 7
Trends in the Mortality Rate Among Medicare Beneficiaries[1]

Study Area	One Year Before Closure	Year of Closure	Post-Closure 1 Year	Post-Closure 2 Years	Percent Change
Closure	36.4	38.4	37.6	38.1	4.7
No Closure	36.5	36.2	35.9	34.9	-4.4
No Hospital	33.7	36.7	35.3	34.7	3.0

* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

[1] The mortality rate is measured as the number of deaths per 1,000 Medicare beneficiaries. Data are age- and sex-adjusted.

NOTE: None of the 4-year trends was statistically significant.

SOURCE: Center for Health Economics Research: Eleven-State Data Base, 1985-89.

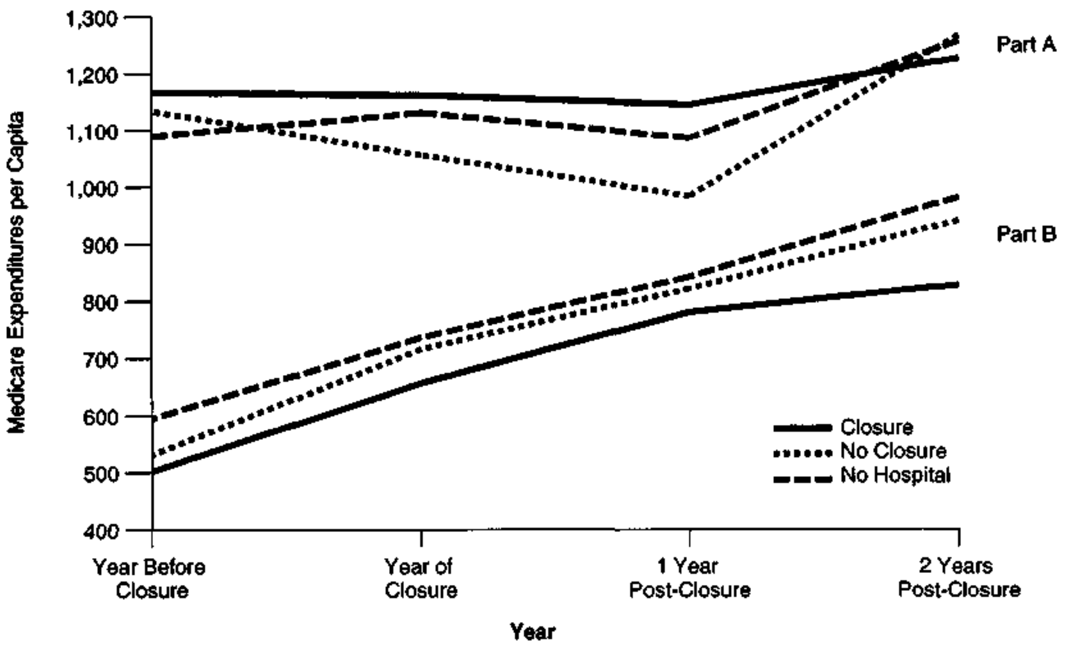
closures have had a detrimental impact on access to health care within the population previously served by the closing hospitals. This study takes a population-based approach by identifying geographic areas served by 11 rural hospitals which closed during 1986 or 1987. Closure areas have been matched to areas not experiencing a closure as well as areas that had no hospital during the period of study (1985-89). Access indicators pertain to both inpatient and outpatient utilization and expenditures among populations residing in the closure and comparison areas. A statistical technique known as profile analysis was used to test the significance of differences in access over time between the closure and comparison areas.

One of the key concerns surrounding hospital closures is whether inpatient discharges would decline. We found that closure areas experienced quite a significant drop in medical admissions in the year of closure, especially relative to the areas with no hospital. In addition, reductions were observed for a few specific case types. For example, discharge rates for ambulatory-care sensitive conditions fell more rapidly in the closure areas relative to the two comparison areas, counter to our expectations. One hypothesis is that physicians in closure areas had a much lower threshold for admitting patients to the hospital prior to the hospital closure. Medical-local discharges also showed more significant reductions in the closure areas, perhaps reflecting the discretionary nature of some of the admissions or, alternatively, the lack of local hospital availability.

In general, baseline utilization rates were higher in closure areas than in the comparison groups, with a considerable narrowing of the gap following the closure. Thus, higher baseline utilization rates in closure areas may be evidence of overutilization pre-closure, such that the reductions post-closure are not indicative of reductions in access, but rather reductions in inappropriate hospitalization. Another explanation for higher baseline utilization might be the lack of community-based health resources (such as pharmacies and home care) that influenced physicians' decisions to admit Medicare patients sooner than they might have if such services were more readily available.

More admissions shifted to urban teaching hospitals following the closure of the rural hospitals in our sample. This may have occurred either because a teaching hospital was the nearest hospital or because the physician or patient chose to bypass a rural hospital. Of the 12 closure areas, 3 had no nearby hospitals (within 15 miles), 7 had 1 hospital nearby, 1 had 2 hospitals, and 1 had 3 hospitals. None of these nearby hospitals were teaching hospitals (Rosenbach and Pitcher, 1990).

Figure 1
Trends in Medicare Expenditures per Capita



SOURCES: Health Care Financing Administration: Medicare Provider Analysis and Review Files, 1985-89; Center for Health Economics Research: Eleven-State Data Base, 1985-89.

Thus, it is likely that patients were bypassing the remaining rural hospitals in favor of urban teaching hospitals.

What happened to per capita inpatient expenditures in the closure areas? Although expenditures grew rapidly in the health care sector overall, growth appeared to be consistently slower in the closure areas, especially compared with the no-hospital areas (Figure 1). This appears to be a function of greater reductions in the discharge rate, coupled with greater reductions in the number of inpatient days. The reductions in inpatient utilization appear to have offset the shift in admissions to more expensive urban hospitals, resulting in a net cost reduction.

This study provides a unique view of trends in physician spending and utilization pre- and post-closure. Analyzing both inpatient and outpatient utilization simultaneously is important because of the possibility that physician services will substitute for inpatient services following a hospital closure. However, this was not found to be the case. Although Part B expenditures grew in both the closure and comparison areas, the rate of growth tended to be slower among those in the closure areas (Figure 1). Impacts were observed by type of service (surgery, consults, and hospital visits) as well as by place of service (inpatient or outpatient hospital). Most of the impacts were observed between 1 and 2 years post-closure. In some cases, the slower rate of growth was due to changes in the number of users, while in other cases the number of services per user showed slower growth (especially for consults). The slower growth in physician spending (and the lack of a substitution effect) may be a function of reductions in physician availability once a hospital closed. For example, prior to the closure, specialists from a nearby city may have provided monthly or biweekly clinics at the local hospital. Once the hospital closed, such clinics may have ceased.

Another concern centers around the effect of hospital closures on out-of-pocket costs for Medicare beneficiaries. We did not observe any adverse impacts on beneficiary liability. In fact, beneficiary outlays under Part B declined in the post-closure period for those residing in areas served by the closing hospital as a result of reductions in utilization.

Study Limitations and Future Research

This article provides evidence of the possible effects of hospital closures on access to care. It should be noted that this study is based on a population that is well-insured. The Medicare population, as a whole, enjoys considerable access to medical care. Further research is required to determine the magnitude of access impacts on more disadvantaged populations, including those covered by Medicaid and the uninsured. We would expect such populations to experience even greater reductions in access following a hospital closure. In this sense, the Medicare population may represent a best-case scenario.

This article examined the impacts of hospital closures on aggregate use and expenditures. Further analysis of episodes of care would be desirable to determine if there are any unintended consequences with regard to hospital readmissions or use of post-acute care. For example, discharge from an urban teaching hospital to a remote rural location without adequate medical or social support might result in increased readmission rates. Alternatively, discharge planners might recognize the lack of medical or social supports and obtain a placement in a rehabilitation or other post-acute-care facility.

The study includes rural areas experiencing hospital closures in 1986 and 1987. Baseline data were examined for 1-year pre-closure. Because hospital closure is a gradual process, many of the effects may be masked by a 1-year baseline. A 2-3 year baseline period would have been preferred, had sufficient data been available. One study found that about one-fourth of all hospital administrators had known for at least 1 year that their hospital would be closing. Another one-fourth had known for 10-12 months (Taggert and Mullner, 1989).

The post-closure period may also have been too short to detect certain adjustments. For example, many of the effects observed in the study occurred with a lag. Additional follow-up would be desirable to ascertain whether we observe a further deterioration of access over time, or whether accommodations are made, as has been observed in areas that have never had a hospital (Reardon et al., 1991). Further study would also be desirable for closures occurring in a later time period (1988 and beyond). As more rural hospitals struggle for financial viability, treatment options will continue to narrow, shifting inpatient care increasingly to urban teaching hospitals. Long-run utilization and expenditure impacts need to be monitored.

This analysis is based on the universe of Part A and Part B Medicare claims for 12 areas that experienced a hospital closure and their matched comparison groups. Because the 12 closure areas represent a sample of all closure areas, and because of variability among the closure and comparison areas, statistical testing was performed. Unfortunately, the small sample sizes restrict the degrees of freedom, and certain results were not found to be statistically significant. Additional research, including a larger number of areas experiencing closures, would be desirable to replicate this analysis with greater statistical power.

Finally, this study leaves unanswered the question of health status impacts of hospital closures. We did not detect significant effects of hospital closures on mortality, an extreme indicator of poor outcomes. A longer time series (beyond 2 years) may be required to adequately test the effect of hospital closures on mortality. Anecdotal evidence suggests that when local emergency back-up is inadequate following hospital closure, preventable mortality may occur (Lefton, 1985). Bindman, Keane, and Lurie (1990) empirically demonstrated that closure of a public hospital in a rural county in California resulted in displacement of a regular provider, more denials of care, declines in health perception as well as social and role function, and increases in pain. Further research on health impacts would be desirable to inform the policy debate regarding the preservation of essential access.

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TECHNICAL NOTE: DEFINITION OF CASE TYPES

Case Type	DRG Number
Ambulatory-Care Sensitive	
Otitis Media and URI	68, 69
Respiratory Infections/Inflammations	79, 80
Chronic Obstructive Pulmonary Disease	88
Adult Simple Pneumonias	89, 90
Adult Bronchitis and Asthma	96, 97
Heart Failure and Shock	127, 129
Hypertension	134
Angina Pectoris	140
Chest Pain	143
Cellulitis	277-278
Diabetes	294
Medical - Local	
Degenerative Nervous System Disorders	12, 13
Transient Ischemic Attack and Precerebral Occlusion	15
Concussion	31-32
Eye Disorders	43-47
Other Ear, Nose and Throat Disorders	64-67, 71-73
Pulmonary Embolism	78
Other Respiratory System Diagnoses	83-84, 94-95, 101, 102, 475
Pleural Effusion	85-86
Pulmonary Edema and Respiratory Failure	87
Respiratory Signs and Symptoms	99, 100
Deep Vein Thrombophlebitis	128
Atherosclerosis	132, 133
Cardiac Arrhythmias	138, 139
Syncope and Collapse	141, 142
Other Digestive Disease Diagnoses	179, 188, 189

Case Type	DRG Number
Peptic Ulcer	176-178
Adult Gastroenteritis	182, 183
Dental & Oral Disorders Excluding Extractions & Restorations	185
Other Hepatobiliary System Diagnoses	202, 205, 206
Biliary Tract Disorder	207, 208
Disorders of the Pancreas Except Malignancy	204
Injury/Fracture Femur/Hip or Pelvis	235, 237
Connective Tissue Disorders	240-241
Medical Back Problems	243
Other Fractures/Sprains/Strains/Dislocations	250, 251, 253, 254
Skin Ulcers	271
Other Skin, Subcutaneous Tissue and Breast Disorders	271-276, 280, 281, 283, 284
Nutrition and Misc. Metabolic Diagnoses	296, 297
Kidney and Urinary Tract Infections	320, 321
Urinary Tract Stones	323, 324
Male Reproductive System Diagnoses	346-350, 352
Infections and Malignancy, Female Reproductive System	366-369
Other Blood Disorders	397, 398, 399
Red Blood Cell Disorders	395
Acute Adjustment Reaction	425
Depression Neurosis	426
Poisoning & Toxic Effects of Drugs	449, 450
Other Injuries, Poisonings, Toxic Effects Diagnoses	444, 445, 447, 454, 455
Other Factors Influencing Health Status	461-467

SOURCE: Codman Research Group, Inc., 1991.

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